Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
RUDN University

Engineering Academy
educational division (faculty/institute/academy) as higher education program developer

COURSE SYLLABUS

APPLIED MECHANICS AND ENGINEERING
field of studies / speciality code and title

The course instruction is implemented within the professional education program of higher education:

01.04.02 APPLIED MATHEMATICS AND COMPUTER SCIENCE
(code and name of direction/specialty)

The mastering of the discipline is carried out within the framework of the implementation of the basic professional educational program of higher education:

BALLISTIC DESIGN OF SPACE COMPLEXES AND SYSTEMS
higher education program profile/specialisation title

2024 y.

1. COURSE GOAL(s)

Discipline "Applied Mechanics and Engineering" is a part of the Master's program "Ballistic design of space complexes and systems" in the direction 01.04.02 "Applied Mathematics and Computer Science" and is studied in the 1st semester of the 1st course. The discipline is realized by the Department of Mechanics and Control Processes. The discipline consists of 4 sections and 18 topics and is aimed at the study of fundamental principles of force, equilibrium, center of gravity and friction, simple liftind machine; analysis of the basic methods for solving typical problems and familiarization with the scope of their application in professional activities.

The purpose of mastering the discipline is formation of fundamental knowledge and skills in applying problem solving methods necessary for professional activities, increasing the overall level of students' literacy in the discipline of Applied Mechanics and Engineering. The students will learn how to apply mechanics principles and theories into advanced research and development applications.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Applied Mechanics and Engineering Systems Design" is aimed at the formation of the following competencies (parts of competencies) in students:

Table 2.1. List of competences formed by students in the course of mastering the discipline (results of mastering the discipline)

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
GC-2	Able to manage the project at all stages of its life cycle	GC-2.1 Formulates a problem whose solution is directly related to achieving the project goal;; GC-2.2 Identifies relationships between tasks and expected outcomes of tasks;; GC-2.3 Within the scope of assigned tasks, identifies available resources and constraints, applicable legal regulations;; GC-2.4 Analyzes the overall project schedule and selects the best way to accomplish tasks based on applicable legal regulations and available resources and constraints;; GC-2.5 Monitors project progress, adjusts schedule plan according to results of monitoring...;
PC-1	Able to formulate goals, objectives of scientific research in the field of applied mathematics and computer science, computer science and modern programming technologies, select methods and means of problem solving	PC-1.1 Possesses fundamental knowledge acquired in mathematical and/or natural sciences, programming and information technology;; PC-1.2 Can find, formulate and solve standard problems in his/her own research activities in the field of applied mathematics and computer science, computer science and modern programming technologies;; PC-1.3 Has practical experience in research activities in applied mathematics and computer science, computer science and modern programming technologies...;
PC-3	Capable of participating in scientific research and development of design solutions in the field of ballistics, dynamics and spacecraft flight control	PC-3.1 Knows basic mathematical methods and modern tools in the field of ballistic design of space complexes and systems;; PC-3.2 Possesses basic knowledge of standards, codes, and regulations for developing design solutions in spacecraft ballistics, dynamics, and mission control;; PC-3.3 Can apply mathematical methods and modern information technologies in conducting scientific research and developing design solutions in the field of ballistics, dynamics and spacecraft flight control;

Competence code	Competence descriptor	Competence formation indicators (within this course)
PC-5	Able to analyze, including in English, techniques for investigating ballistic and dynamic characteristics in spacecraft flight trajectory modeling	PC-5.1 Knows established and applied techniques, including those from English-language sources, for investigating ballistic and dynamic performance in spacecraft flight path modeling;; PC-5.2 Know how to develop and modernize techniques for investigating ballistic and dynamic characteristics in spacecraft flight trajectory modeling;; PC-5.3 Possesses methods and approaches to investigate ballistic and dynamic characteristics in spacecraft flight trajectory modeling;

3. PLACE OF THE DISCIPLINE IN THE STRUCTURE OF OPVO

The discipline "Applied Mechanics and Engineering Systems Design" belongs to the part formed by participants of educational relations of block 1 "Disciplines (modules)" of the educational program of higher education.

Within the framework of the educational program of higher education students also master other disciplines and/or practices that contribute to the achievement of the planned results of the discipline "Applied Mechanics and Engineering Systems Design".

Table 3.1. List of the components of the EP HEI, contributing to the achievement of the planned results of mastering the discipline

Cipher	Name of competence	Previous disciplines/modules, practices*	Subsequent disciplines/modules, practices*
GC-2	Able to manage the project at all stages of its life cycle		Practical Training in Receiving Remote Sensing Data from Satellites and its Interpretation (online from RUDN Mission Control Center) / NIR; Pre-Graduation Internship in Industry; Aerospace Systems; System Design; Dynamics and Control of Space Systems; Project "Drone Systems Engineering. Part 1"; Project "Drone Systems Engineering. Part 2";
PC-1	Able to formulate goals, objectives of scientific research in the field of applied mathematics and computer science, computer science and modern programming technologies, select methods and means of problem solving		Pre-Graduation Internship in Industry; Practical Training in Receiving Remote Sensing Data from Satellites and its Interpretation (online from RUDN Mission Control Center) / NIR; Practical Training and Research in Dynamics and Control of Space Systems (online from RUDN Mission Control Center); Technological Training;

Cipher	Name of competence	Previous disciplines/modules, practices*	Subsequent disciplines/modules, practices*
			Advanced Methods of Remote Sensing and Geoinformation Systems; System Design; Dynamics and Control of Space Systems;
PC-3	Capable of participating in scientific research and development of design solutions in the field of ballistics, dynamics and spacecraft flight control		Pre-Graduation Internship in Industry; Practical Training in Receiving Remote Sensing Data from Satellites and its Interpretation (online from RUDN Mission Control Center) / NIR; Practical Training and Research in Dynamics and Control of Space Systems (online from RUDN Mission Control Center); Technological Training; Aerospace Systems; Structures & Materials Modelling; System Design; On-board Energy; Dynamics and Control of Space Systems; Project "Drone Systems Engineering. Part 1"; Project "Drone Systems Engineering. Part 2";
PC-5	Able to analyze, including in English, techniques for studying ballistic and dynamic characteristics in spacecraft flight trajectory modeling		Pre-Graduation Internship in Industry; Practical Training in Receiving Remote Sensing Data from Satellites and its Interpretation (online from RUDN Mission Control Center) / NIR; Practical Training and Research in Dynamics and Control of Space Systems (online from RUDN Mission Control Center); Technological Training; Aerospace Systems; Structures & Materials Modelling; System Design; On-board Energy; Dynamics and Control of Space Systems; Advanced Methods of Remote Sensing and Geoinformation Systems;

* - to be filled out in accordance with the competence matrix and the IPS of the Program of study

** - elective disciplines/practices

4. SCOPE OF THE DISCIPLINE AND TYPES OF ACADEMIC WORK

The total labor intensity of the discipline "Applied Mechanics and Engineering" is "6" credit units.

Table 4.1. Types of academic work by periods of mastering the educational program of higher education for full-time education.

Type of training work	**TOTAL,** ac.h.		**Semester(s)**
			1
Contact work, ac.h.	*20*		*20*
Lectures (**LK**)	10		10
Laboratory work (**LW**)	0		0
Practical/seminar classes (**SP**)	10		10
Independent work of students, ac.h.	*160*		*160*
Control (exam/assessed credit), ac.h.	*36*		*36*
Total labor intensity of the discipline	**ac.h.**	***216***	*216*
	credit.	***6***	*6*

5. DISCIPLINE CONTENT

Table 5.1. Content of the discipline (module) by types of academic work

Section number	Name of the discipline section	Content of the section (topic)		Type of training work*
Section 1	Force	1.1	Fundamentals	LK, NW
		1.2	Force	LK, NW
		1.3	Resolution of a force	LK, NW
		1.4	Moment of a force	LK, NW
		1.5	Force system	LK, NW
		1.6	Composition of Forces	LK, NW
Section 2	Equilibrium	2.1	Definition, conditions of equilibrium	LK, NW
		2.2	Lami's Theorem	LK, NW
		2.3	Equilibrant	LK, NW
		2.4	Beams	LK, NW
Section 3	Center of Gravity and Friction	3.1	Centroid	LK, NW
		3.2	Center of gravity	LK, NW
		3.3	Definition of friction, force of friction	LK, NW
		3.4	Equilibrium of bodies on level plane	LK, NW
		3.5	Equilibrium of bodies on inclined plane	LK, NW
Section 4	Simple Liftind Machine	4.1	Definitions of simple machine	LK, NW
		4.2	Law of machine, maximum mechanical advantage	LK, NW
		4.3	Study of simple machines	LK, NW

* - to be filled in only for **full-time** education: *LK - lectures; LL - laboratory work; SL - practical/seminar classes.*

6. MATERIAL AND TECHNICAL SUPPORT OF THE DISCIPLINE

Table 6.1. Material and technical support of the discipline

Audience type	Classroom equipment	Specialized training/laboratory equipment, software and materials for mastering the discipline (if necessary)
Lecture	Auditorium for lecture-type classes, equipped with a set of specialized furniture; blackboard (screen) and technical means of multimedia presentations.	
Seminar	Auditorium for seminars, group and individual consultations, current control and interim certification, equipped with a set of specialized furniture and technical means of multimedia presentations.	
For independent work	Auditorium for independent work of students (can be used for seminars and consultations), equipped with a set of	

Audience type	Classroom equipment	Specialized training/laboratory equipment, software and materials for mastering the discipline (if necessary)
	specialized furniture and computers with access to the EIOS.	

* - classroom for independent work of students is indicated **MUST** be indicated!

7. EDUCATIONAL-METHODICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

Primary Literature:

1. "Vector Mechanics for Engineers: Statics and Dynamics," by Beer, Johnston, and Eisenberg, McGraw-Hill, 10th Edition.
2. "Materials Science and Engineering, William D. Callister Jr. and David G. Rethwisch, 9th ed., SI Version, John Wiley & Sons, 2014
3. "Shigley's Mechanical Engineering Design", Richard G Budynas and Keith J Nisbett, 10th ed, McGraw-Hill Higher Education, 2014

Supplementary Literature:

1. "Elasticity", James R. Barber, 3rd ed., Dordrecht: Springer Netherlands, 2010. On-line version available through CityU library.
2. "Mechanics of materials," Barry J. Goodno and James M. Gere, 9th ed., SI Version, Cengage Learning, 2018.

Resources of the information and telecommunication network "Internet":

1. RUDN EBS and third-party EBS, to which the university students have access on the basis of concluded agreements
   - PFUR Electronic Library System - PFUR EBS http://lib.rudn.ru/MegaPro/Web
   - EBS "University Library Online" http://www.biblioclub.ru
   - EBS Yurait http://www.biblio-online.ru
   - EBS "Student Consultant" www.studentlibrary.ru
   - Trinity Bridge EBS
2. databases and search engines
   - electronic fund of legal and normative-technical documentation http://docs.cntd.ru/
   - Yandex search engine https://www.yandex.ru/
   - Google search engine https://www.google.ru/
   - SCOPUS abstract database http://www.elsevierscience.ru/products/scopus/

Educational and methodical materials for independent work of students in mastering the discipline/module:*

1. Course of lectures on the discipline "Applied Mechanics and Engineering Systems Design".

* - all educational and methodical materials for independent work of students are placed in accordance with the current order on the page of the discipline **in TUIS**!

8. EVALUATION MATERIALS AND SCORING AND RATING SYSTEM FOR ASSESSING THE LEVEL OF COMPETENCIES IN THE DISCIPLINE

Evaluation materials and point-rating system* of assessing the level of competencies (part of competencies) formed by the results of mastering the discipline "Applied Mechanics and

Engineering Systems Design" are presented in the Appendix to this Working Program of the discipline.

* - OM and BRS are formed on the basis of the requirements of the relevant RUDN local normative act.

DEVELOPER:

Professor		Sergey Alekseevich Kupreev
Position, BUP	*Signature*	*Last Name First Name.*

HEAD OF BUP:

Head of Department		Razumny Yuri Nikolayevich
BUP position	*Signature*	*Last Name First Name.*

HEAD OF OPS WO:

Professor		Razumny Yuri Nikolayevich
Position, BUP	*Signature*	*Last Name First Name.*